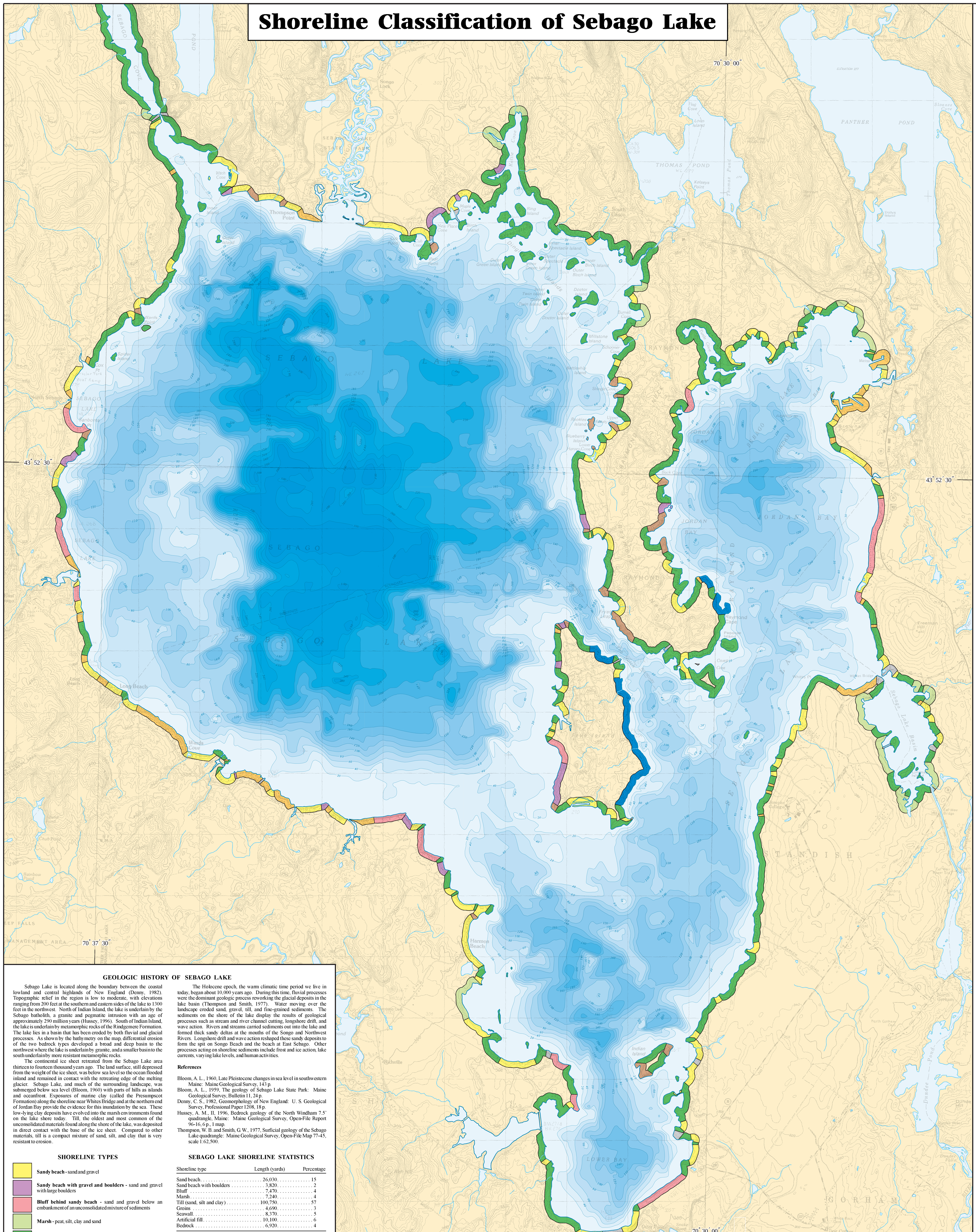
Shoreline Classification of Sebago Lake



Sebago Lake, Maine

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CHANGING SHORELINES AT SEBAGO LAKE

Sebago Lake is Maine's second largest lake and covers an area of approximately 47.5 square miles. It is the deepest lake in Maine and extends 50 feet below sea level. Sand beaches and bluffs are the most dynamic of all the geologic environments on the shores of Sebago Lake. Important agents of shoreline change that affect these ecosystems are waves, wind, lake levels, storms, ice action, currents, and human activity.

Wind and waves are the most important agents of shoreline change at Sebago Lake. Waves are formed by wind and their size depends on the strength and duration of the wind, as well as the distance the wave travels (fetch). The higher the wind strength, the longer the wind blows, and the longer the fetch, the larger the wave. Tropical (hurricanes) and extra-tropical (nor'easters) storms have caused the largest changes in Sebago Lake shorelines. The strongest winds and largest waves form during these events. Waves created by boat wakes in certain constricted areas of the lake may also play a role in shoreline erosion.

Lake levels also affect erosion around the lake. Shoreline erosion became a concern at Sebago Lake in the mid 1980's when the S. D. Warren Paper Company, the owner of the Eel Weir Dam, changed their water level management plan. Before 1986 there was no specific rule curve for the water levels. In 1986, S. D. Warren began to hold more water in the lake during the fall and winter months. This raising of the water levels brought an increased number of complaints about erosion of the sand beaches due to the higher water levels. In response to these complaints, water levels in the lake are now governed by a water level management plan developed by S. D. Warren, the Federal Energy Regulatory Commission, the Portland Water District, various state agencies, and local citizen groups (FERC, 1997).

Ice and frost action affect unconsolidated materials along the shore of the lake. Freezing and thawing of shoreline sediments contributes to slumping in areas with steep slopes. Each spring the breakup of winter ice causes the bulldozing of unconsolidated materials around the lake. This berm is usually redistributed by wave action and lake level rise during the spring months (Dickson and Johnston, 1994).

Currents and longshore drift in Sebago Lake affect the movement of fine-grained materials. The spit at Songo Beach was built by longshore drift and wave action.

Human influences affecting Sebago Lake's shorelines include foot traffic in sensitive areas, boat wakes, dredging, sea wall and groin construction, and recreational vehicle tracks. Erosion problems and continuing lakeshore development have led to the construction of man-made seawalls and other erosion barriers. Dredging and groin construction in some areas disrupt the natural movement of sand along the shoreline. Large boat wakes cause problems when they impact sedimentary shorelines, especially in narrow channels.

The shoreline of Sebago Lake is very dynamic. Shoreline environments respond differently to both the natural and human forces that act upon them. Monitoring of shoreline change is important to understand coastal processes in order to further protect this valuable lake.

References

Dickson, S. M., and Johnston, R. A., 1984, Sebago Lake State Park beach dynamics: A report on results of beach profiling: Maine Geological Survey, Open-File Report 94-4, 189 p.
Federal Energy Regulatory Commission, 1997, Eel Weir Hydroelectric Project, Final Environmental Impact Statement: FERC No. 2984-025, Maine, Washington, D. C.
Johnston, R. A., and Mixon, M. N., 1998, Beach dynamics of Sebago Lake: Maine Geological Survey, Open-File Report 98-122, 273 p.

Sand Beach. Sandy sediments that can extend from above the high water mark to hundreds of feet offshore. Composed of fine- and coarse-grained sand, beaches are the most erodable environments found along the shore and vary in width due to slopes and lake level.

Sand beach with boulders. Sand is both fine- and coarse-grained and forms low ridges, mounds, or flat sloping surfaces. Sand is easily eroded by waves while boulders are more resistant.

Bluff with an unvegetated or slightly vegetated bluff face. Sandy sediments on the bluff face are exposed and boulders lie at the base of the bluff. Vegetated bluffs are generally stable while unvegetated bluffs are commonly eroding.

Freshwater Marsh. Low-lying vegetated area composed of an abundance of fine-grained silt, clay, and organics from marsh plants. Marshes often reduce wave energy along the upland shore and have slow erosion rates.

Till. Heterogeneous mixture of sand, silt, clay, and gravel. Unit generally overlies bedrock and is fairly resistant to erosion due to a boulder armor that waves cannot move.

Groin. Shore protection structure made from large rocks commonly found along the eastern shore of Frye Island. Built perpendicular to shore, groins trap sand moving in longshore currents and reduce erosion of the shore. Sand beaches are often found between groins.

Seawall landward of a sand and/or gravel beach shoreline. Sebago Lake's seasonal 4.5 foot water level fluctuation often covers the beach and waves impact and reflect off portions of the seawalls. Wave reflection leads to beach lowering.

Artificial Fill. Introduced fill material, commonly concrete, riprap, or similar sized rocks. Fairly resistant to erosion, however older solid structures are subject to subsidence, cracking, and disintegration over time.

Bedrock or Ledge. Massive units of either granite or metamorphic rock. Very resistant to erosion. May be low-lying or form vertical cliffs.

HOW TO USE THIS MAP

Types of Information Shown on this Map: Colored areas along the lake shore indicate different sedimentary environments. The environments were delineated by a geologist based on field observations and limited aerial photo interpretation. Inlet streams and upland areas of the lake were not mapped. The bathymetric data shown on the map shows the depth of water in the lake with a 20 foot contour interval. Lake depth data used to construct the map were provided by the Maine Department of Inland Fisheries and Wildlife; Maine Department of Conservation: Bureau of Parks & Lands (Waterways Division) and the Maine Geological Survey; and the Portland Water District. Bathymetric lines, based on over 2100 depth points, were contoured using a geographic information system and smoothed by a geologist. The same contour interval is used on land.

Uses of this Map: Shoreline classifications on the map provide information on the type and erodability of sediments along the lake shore. This information may be useful when making decisions about construction or other shoreline uses. Land and home owners, planners, government officials, and recreational users can use this information to better manage the lake's natural resources. Buildings would be best suited inland of the more erosion-resistant enviroments. Public use areas would be better located on sandy beaches. When used in conjunction with other geologic information, surficial geology maps for instance, this map can help make more informed decisions to safeguard the water quality of Sebago Lake.

More Information: Johnston, R. A., and Mixon, M. N., 1998, Beach dynamics of Sebago Lake: Maine Geological Survey, Open-File Report 98-122, 273 p.

GEOLOGIC HISTORY OF SEBAGO LAKE

Sebago Lake is located along the boundary between the coastal lowland and central highlands of New England (Denny, 1982). Topographic relief in the region is low to moderate, with elevations ranging from 200 feet at the southern and eastern sides of the lake to 1300 feet in the northwest. North of Indian Island, the lake is underlain by the Sebago batholith, a granite and pegmatite intrusion with an age of approximately 290 million years (Hussey, 1996). South of Indian Island, the lake is underlain by metamorphic rocks of the Rindgemere Formation. The lake lies in a basin that has been eroded by both fluvial and glacial processes. As shown by the bathymetry on the map, differential erosion of the two bedrock types developed a broad and deep basin to the northwest where the lake is underlain by granite, and a smaller basin to the south underlain by more resistant metamorphic rocks.

The continental ice sheet retreated from the Sebago Lake area thirteen to fourteen thousand years ago. The land surface, still depressed from the weight of the ice sheet, was below sea level so the ocean flooded inland and remained in contact with the retreating edge of the melting glacier. Sebago Lake, and much of the surrounding landscape, was submerged below sea level (Bloom, 1960) with parts of hills as islands and oceanfront. Exposures of marine clay (called the Presumpscot Formation) along the shoreline near Whites Bridge and at the northern end of Jordan Bay provide the evidence for this inundation by the sea. These low-lying clay deposits have evolved into the marsh environments found on the lake shore today. Till, the oldest and most common of the unconsolidated materials found along the shore of the lake, was deposited in direct contact with the base of the ice sheet. Compared to other materials, till is a compact mixture of sand, silt, and clay that is very resistant to erosion.

The Holocene epoch, the warm climatic time period we live in today, began about 10,000 years ago. During this time, fluvial processes were the dominant geologic process reworking the glacial deposits in the lake basin (Thompson and Smith, 1977). Water moving over the landscape eroded sand, gravel, till, and fine-grained sediments. The sediments on the shore of the lake display the results of geological processes such as stream and river channel cutting, longshore drift, and wave action. Rivers and streams carried sediments out into the lake and formed thick sandy deltas at the mouths of the Songo and Northwest Rivers. Longshore drift and wave action reshaped these sandy deposits to form the spit on Songo Beach and the beach at East Sebago. Other processes acting on shoreline sediments include frost and ice action, lake currents, varying lake levels, and human activities.

References

Bloom, A. L., 1960, Late Pleistocene changes in sea level in southwestern Maine: Maine Geological Survey, 143 p.
Bloom, A. L., 1959, The geology of Sebago Lake State Park: Maine Geological Survey, Bulletin 11, 24 p.
Denny, C. S., 1982, Geomorphology of New England: U. S. Geological Survey, Professional Paper 1208, 18 p.
Hussey, A. M., II, 1996, Bedrock geology of the North Windham 7.5' quadrangle, Maine: Maine Geological Survey, Open-File Report 96-16, 6 p., 1 map.
Thompson, W. B. and Smith, G. W., 1977, Surficial geology of the Sebago Lake quadrangle: Maine Geological Survey, Open-File Map 77-45, scale 1:62,500.

SHORELINE TYPES

- **Sandy beach** - sand and gravel
- **Sandy beach with gravel and boulders** - sand and gravel with large boulders
- **Bluff behind sandy beach** - sand and gravel below an embankment of an unconsolidated mixture of sediments
- **Marsh** - peat, silt, clay and sand
- **Till** - heterogeneous mixture of gravel, sand, silt, and clay
- **Groins alternating with sandy beach** - sand and gravel between shore-perpendicular jetties
- **Seawall landward of sandy beach** - sand and gravel in front of artificial fill
- **Artificial fill** - large angular quarry rock, sediments, or concrete
- **Bedrock** - solid rock exposures, sparse sediment

Note: The classification of the shoreline is indicated by a colored band extending landward from the shoreline. The width of the band is for legibility purposes and is NOT related to the width of the shoreline zones.

SEBAGO LAKE SHORELINE STATISTICS

Shoreline type	Length (yards)	Percentage
Sand beach	26,030	15
Sand beach with boulders	3,820	2
Bluff	7,470	4
Marsh	7,240	4
Till (sand, silt and clay)	100,750	57
Groins	4,690	3
Seawall	8,370	5
Artificial fill	10,100	6
Bedrock	6,920	4
Total length of shoreline	175,390	100

GRAIN-SIZE SCALE

	Size Class	Grain Diameter	
Gravel	Boulders	256 to 40,096 mm	(10.1 to 161.3 inches)
Gravel	Cobbles	64 to 256 mm	(2.5 to 10.1 inches)
Gravel	Pebbles	2 to 64 mm	(0.08 to 2.5 inches)
	Sand	0.062 to 2 mm	
Mud	Silt	0.004 to 0.062 mm	
Mud	Clay	0.00025 to 0.004 mm	

from Wentworth, C. K., 1922, A scale of grade and class terms for clastic sediments: Journal of Geology, v. 30, p. 377-392.

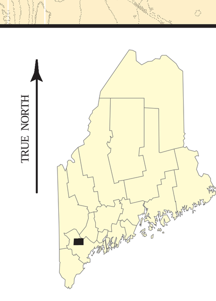
Methods: Mapping surveys were conducted by boat and data were checked by air photo interpretation. Field maps were digitized and edited on an ARC/INFO geographic information system.

Accuracy: Delineation of shoreline types is subject to change based on additional information. Contact the Maine Geological Survey at 207-287-2801 for corrections or additions. Estimated accuracy is 5 yards between classification types.

Not to be Used for Navigation
The information appearing on this map is not complete for navigation.

SCALE 1 : 24,000
1 0 1 MILE
1000 0 1000 2000 3000 4000 5000 6000 7000 FEET
1 0 1 KILOMETER

Contour interval: 20 feet
(both land surface and bathymetry)



Quadrangle Location

Topographic base from U.S. Geological Survey Naples, North Windham, North Sebago, Raymond, Sebago Lake, and Steep Falls quadrangles, scale 1:24,000 using standard U.S. Geological Survey topographic map symbols.